# FINAL REPORT

## JONES RIVER ESTUARY AND KINGSTON BAY STORMWATER ASSESSMENT PROJECT

## MASSACHUSETTS BAYS PROGRAM RESEARCH & PLANNING GRANTS

TOWN OF KINGSTON

DECEMBER 28, 2011

*ATP ENVIRONMENTAL*
*MELROSE, MA*

# EXECUTIVE SUMMARY

The Jones River Estuary and Kingston Bay Stormwater Assessment Project was been completed pursuant to a grant from the Massachusetts Bays Program. End-of-pipe sampling at outfalls and other stormwater runoff points was completed during the "first flush" of two separate storm events, one in September 2011 and one in October 2011. All sampling and analysis was completed pursuant to a Quality Assurance Project Plan (QAPP) approved at the outset by USEPA.

Beginning with 35 known stormwater discharge points, the Town identified nineteen locally controlled locations representing potential sources for stormwater contamination. The nineteen sites were mapped, along with two outfall sites controlled by Mass DOT on Route 3, and an analysis completed to determine which sites should be subject to further study. Fifteen of the sites were selected for water quality sampling during two storm events, and analyzed for bacterial contamination (fecal coliform and enterococci) and total suspended solids. The results of the two sampling rounds were tabulated and examined along with other parameters.

Based upon the results of the two sampling rounds, twelve sites were identified for an assessment of stormwater mitigation measures that might be considered for future implementation. Best Management Practices (BMPs), as defined in the Massachusetts Stormwater Handbook, were identified for each location. Conceptual designs were completed for ten sites while a more detailed preliminary engineering design was performed at two sites. The ten conceptual designs were presented on 100-scale drawings; the two sites subject to preliminary design were presented on drawings at twenty scale.

Based upon the conceptual and preliminary designs, an estimate was made of construction cost for implementation of BMPs. The construction costs were developed using material quantities generated from the BMP designs and applying unit prices recently observed for other nearby stormwater mitigation projects of similar scale. For the twelve sites it was estimated that final design, construction, and engineering inspection would cost $825,170. Of the total cost, $268,778 is estimated for the two sites subject to preliminary engineering while the balance ($556,392) is estimated for the ten sites subject to conceptual design.

Future actions are recommended in the Assessment Report. Principal among them is the identification of grant programs that can be sought for implementation (construction) funding of stormwater mitigation BMPs in the Commonwealth. The next best opportunity for Kingston will be in the Fall of 2012 when proposals will be sought by the Office of Coastal Zone Management under the Coastal Pollutant Remediation grant program. It is recommended the the Town make application when the opportunity presents itself. Also, the Town is currently investigating improvements to the Town Landing site. It is recommended that, should the Landing project proceed to final design, the stormwater BMPs prepared as part of this study be incorporated in the recommended site improvements and be included as part of a CPR application.

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# REPORT

## I. WATERSHED MAPPING AND MEASUREMENT

Working with Maureen Thomas, Kingston Conservation Agent, ATP Environmental identified nineteen outfalls into the Jones River and related tributaries controlled by the Town of Kingston. The outfalls were mapped and an estimate was made of the "first flush" volume related to each. Distance from the mouth of the river, in river miles, and distance from the Jones River itself were both determined as a way of assessing potential for adverse impacts to the river and Kingston Bay. Two other outfalls controlled by MassHighways on Route 3 and discharging to the Jones River were also identified by the Town as outfalls of interest. A 200 Scale map was developed showing the location of all outfall sites (Figure 1). Table 1 below lists all Town outfalls, their individual outfall IDs, first flush volume, and important distance metrics.

**TABLE 1 - FIRST FLUSH CALCULATIONS**

| No. | Outfall ID | Street Name | Length | Width | Area (SF) | FF (CF) | Subtotal FF | Dist. to River Feet | River Mi. to Mouth |
|---|---|---|---|---|---|---|---|---|---|
| 1 | #059 | Shore Drive | 415 | 24 | 9,960 | 827 | | | |
| | | Page Avenue | 211 | 21 | 4,431 | 368 | | | |
| | | Cedar Lane | 454 | 24 | 10,896 | 904 | | | |
| | | | | | | | 2,099 | 0 | 0 |
| 2 | Paved Swale #1 | Holmes Ave | 718 | 18 | 12,924 | 1,073 | | | |
| | | Delano Ave | 253 | 26 | 6,578 | 546 | | | |
| | | | | | | | 1,619 | 0 | 0 |
| 3 | Paved Swale #2 | Cobb Ave | 712 | 15 | 10,680 | 886 | | | |
| | | | | | | | 886 | 0 | 0 |
| 4 | Paved Swale #3 | Seaver Ave | 635 | 15 | 9,525 | 791 | | | |
| | | | | | | | 791 | 0 | 0 |
| 5 | #060 | Drew Ave | 422 | 15 | 6,330 | 525 | | | |
| | | | | | | | 525 | 0 | 0 |
| 6 | Paved Swale #4 | Delano Ave | 564 | 24 | 13,536 | 1,123 | | | |
| | | Adams Ave | 80 | 15 | 1,200 | 100 | | | |
| | | Drew Ave | 43 | 15 | 645 | 54 | | | |
| | | Grandview Ave | 270 | 15 | 4,050 | 336 | | | |
| | | | | | | | 1,613 | 0 | 0 |
| 7 | #041B | Bay Farm Rd E | 434 | 20 | 8,680 | 720 | | | |
| | | Bay Farm Rd N | 450 | 20 | 9,000 | 747 | | | |
| | | Bay Side Lane | 10 | 10 | 100 | 8 | | | |
| | | | | | | | 1,476 | 0 | 0.09 |
| 8 | #041A | River Street | 519 | 24 | 12,456 | 1,034 | | | |
| | | Loring Road | 460 | 22 | 10,120 | 840 | | | |
| | | Franklin Street | 316 | 10 | 3,160 | 262 | | | |
| | | Marsh Road | 266 | 22 | 5,852 | 486 | | | |
| | | Pier Area | 340 | 40 | 13,600 | 1,130 | 3,752 | 0 | 0.19 |

| | | | | | | | Subtotal | Dist. to River | River Mi. |
|---|---|---|---|---|---|---|---|---|---|
| | Outfall ID | Street Name | Length | Width | Area (SF) | FF (CF) | FF | Feet | to Mouth |
| 9 | #041 | Loring Road | 276 | 22 | 6,072 | 504 | | | |
| | | Marsh Road | 445 | 22 | 9,790 | 813 | | | |
| | | Arrow Street | 436 | 22 | 9,592 | 796 | | | |
| | | Jones River Dr | 238 | 22 | 5,236 | 435 | | | |
| | | | | | | | 2,547 | 0 | 0.32 |
| 10 | #043 | Maple Street | 760 | 30 | 22,800 | 1,892 | | | |
| | | Wright Court | 0 | 25 | 0 | 0 | | | |
| | | Dwy | 236 | 20 | 4,720 | 392 | | | |
| | | | | | | | 2,284 | 500 | 1.86 |
| 11 | #051A | Riverside Drive | 1495 | 30 | 44,850 | 3,723 | | | |
| | | Pearl Street | 331 | 26 | 8,606 | 714 | | | |
| | | | | | | | 4,437 | 200 | 2.08 |
| 12 | #195 | Maple Street | 444 | 30 | 13,320 | 1,106 | | | |
| | | Landing Road | 667 | 37 | 24,679 | 2,048 | | | |
| | | Dwy | 300 | 10 | 3,000 | 249 | | | |
| | | | | | | | 3,403 | 0 | 1.63 |
| 13 | #196 | Electric Substation | | | 0 | 0 | | | |
| | | | | | | | 0 | 0 | 1.70 |
| 14 | #197 | Landing Road | 802 | 24 | 19,248 | 1,598 | | | |
| | | Field Access Road | 406 | 24 | 9,744 | 809 | | | |
| | | | | | | | 2,406 | 0 | 1.70 |
| 15 | #198 | Upland? | | | 0 | 0 | | | |
| | | | | | | | 0 | 0 | 1.75 |
| 16 | #047B | Jones River Dr | 730 | 22 | 16,060 | 1,333 | | | |
| | | River Street | 620 | 24 | 14,880 | 1,235 | | | |
| | | | | | | | 2,568 | 400 | 1.34 |
| 17 | #047 | Jones River Dr | 638 | 22 | 14,036 | 1,165 | | | |
| | | | | | | | 1,165 | 100 | 0.91 |
| 18 | #057A | Jones River Dr | 393 | 22 | 8,646 | 718 | | | |
| | | | | | | | 718 | 100 | 0.42 |
| 19 | #193 | Park Street | 912 | 21 | 19,152 | 1,590 | | | |
| | | | | | | | 1,590 | 1000 | 1.78 |

## II. SELECTING OUTFALLS FOR SAMPLING

Using the above data, ATP recommended that 10 outfalls be sampled based upon the "first flush" volume generated from one inch of runoff and the proximity of the discharge to Kingston Bay. One inch of runoff was used because shellfish areas in Kingston Bay represent the natural resource of concern. Outfalls with elevated first flush volumes discharging at or near the mouth of the River, or that were high in volume within 2 miles from the mouth of the River, were selected to be sampled under two storm events. The Town added three other local outfalls based upon their observations in the past, and two outfalls managed by Mass DOT. Table 2 below lists all fifteen outfalls ultimately selected for sampling during two rain events.

| Table 2 - Recommended Sampling Priority | | | | |
|---|---|---|---|---|
| No. | Outfall ID | First Flush CF | Dist. to River Feet | River Mile to Mouth |
| 1 | #059 | 2099 | 0 | 0.00 |
| 2 | #041A | 3752 | 0 | 0.19 |
| 3 | #041B | 1476 | 0 | 0.09 |
| 4 | #041 | 2547 | 0 | 0.32 |
| 5 | #047 | 1162 | 100 | 0.91 |
| 6 | #047B | 2568 | 400 | 1.34 |
| 7 | #051A | 4437 | 200 | 2.08 |
| 8 | #195 | 3403 | 0 | 1.63 |
| 9 | #197 | 2406 | 0 | 1.70 |
| 10 | #043 | 2284 | 500 | 1.86 |
| 11 | #198 | Unknown | 0 | 1.75 |
| 12 | #193 | 1590 | 1000 | 1.78 |
| 13 | PS#4 | 1613 | 0 | 0 |
| 14 | MDOT 1 | Unknown | 0 | 1.14 |
| 15 | MDOT 2 | Unknown | 0 | 1.56 |

## III. SAMPLING and ANALYSIS

Two rounds of wet weather sampling were undertaken by the Town of Kingston lead by Maureen Thomas. The first sampling round was conducted on September 22, 2011 followed by a second sampling round October 27, 2011. Sampling protocols were followed as prescribed in the Sampling and Analysis QAPP prepared by the Town and approved by USEPA. Outfalls were sampled where accessible; immediate upstream catchbasins were sampled when necessary. Samples in both rounds were analyzed for bacteria (fecal coliform and enterococci), and total suspended solids. Duplicates were taken at three outfalls during both sampling events.

The results of the two sampling rounds were plotted and analyzed by ATP Environmental. Because of the wide disparity of bacteria values between events at some locations, it was decided to calculate the geometric mean of values, rather than a simple average, to assess the level of contamination. As can be seen on Table 3, the geometric mean for fecal coliform counts ranged from 52 cfu/100 ml at the playground DMH (Outfall #198) to 13,856 cfu/100 ml at the Marsh Road outfall (#041) with an average of 5,417 cfu/100 ml for all fifteen sample sites. The geometric mean for enterococci ranged from 856 cfu/100 ml (again, #198) to 39,950 at the Delano Ave. paved swale (PS#4) with an average of 16,962 cfu/100 ml for all fifteen sample sites. Total suspended solids values ranged from 6 mg/l at Jones River Road #5 (Outfall #047B) to 33 mg/l at the Maple Street outfall (#043) with an average value of 17 mg/l across all fifteen sites. (Note: TSS values represent arithmetic average values, not geometric mean values, because TSS values between sample rounds did not vary significantly).

**TABLE 3 - RESULTS OF SAMPLING AND ANALYSIS**

Jones River Estuary and Kingston Bay
Stormwater Assessment Project

MBP GRANT: ENV 11 CZM 02

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAMPLING DATE | | 09/22/2011 | | | | | | | | | | | SAMPLING DATE | 10/27/2011 | | | | | |
| | WEATHER | | Light Rain, 63 degrees, calm, 30.16 S | | | | | | | | | | | WEATHER | Light Rain, 47 degrees, calm, 29.71 S | | | | | |
| | TIDE | | 2 Hrs either side of HT | | | | | | | | | | | TIDE | 2 to 4 hours into Flood | | | | | |
| | PRECEDING CONDITIONS | | No Rain Documented in Previous 72 hours | | | | | | | | | | | PRECEEDING CONDITIONS | dry 72 Hrs prior except: 0.01" 44hrs prior; 0.02" 20hrs prior | | | | | |
| | RAINFALL EVENT | | 0.5 in. between 0100 and 0900 | | | | | | | | | | | RAINFALL EVENT | 0.25 in. between 0630 and 1030 | | | | | |
| | SAMPLING PERIOD | | 0515 TO 0920 | | | | | | | | | | | SAMPLING PERIOD | 0719 to 1020 | | | | | |
| | | | | | | | | | | | | | | | | | | MASS BALANCE | | |
| SAMPLE ID | SAMPLE LOCATION | RANK | SAMPLE POINT | SAMPLE TIME | SAMPLE TIME | | | **RESULTS** | | | | | | GEOMETRIC MEAN | | | FIRST FLUSH | x10^6 | x10^6 | x10^3 | SAMPLE ID | SAMPLE LOCATION |
| | | | | | | Fecal Coliform: CFU/100ml | | Enterococci: CFU/100ml | | TSS: mg/l | | | | | | | | | | |
| | | | | SEPT. | OCT. | SEPT. | OCT. | SEPT. | OCT. | SEPT. | OCT. | FECAL | ENTEROCOCCI | TSS | CF | Fecal Units | Entero. Units | TSS: mg | | |
| #59 | Shore Drive | | Outfall | 515 | 728 | 10000 | 2400 | 8000 | 21000 | 16 | 24 | 4,899 | 12,961 | 20 | 2099 | 2,912 | 7,705 | 11,889 | #59 | Shore Drive |
| #59 | Shore Drive Dup. | | | 515 | | 15000 | | 16000 | | 18 | | | | | | | | | #59 | Shore Drive Dup. |
| Paved Swale #4 | Delano Ave | 2 | Surface | 505 | 719 | 38000 | 4600 | 28000 | 57000 | 24 | 8 | 13,221 | 39,950 | 16 | 1613 | 6,039 | 18,249 | 7,309 | Paved Swale #4 | Delano Ave |
| #041A | Town Ld'g-River Street | 4 | CB upstream | 534 | 741 | 13000 | 6400 | 5100 | 43000 | 10 | 10 | 9,121 | 14,809 | 10 | 3752 | **9,692** | 15,735 | 10,626 | #041A | Town Ld'g-River Street |
| #041A | Town Ld'g-River Street Dup | | | | 742 | | 2500 | | 41000 | | 6 | | | | | | | | #041A | Town Ld'g-River Street Dup |
| #041B | Bay Farm Road | | Outfall | 544 | 752 | 2500 | 110 | 4900 | 1700 | 10 | 20 | 524 | 2,886 | 15 | 1476 | 219 | 1,206 | 6,270 | #041B | Bay Farm Road |
| #041 | Marsh Road | 2 | CB upstream | 642 | 800 | 80000 | 2400 | 16000 | 32000 | 10 | 24 | 13,856 | 22,627 | 17 | 2547 | **9,995** | 16,321 | 12,262 | #041 | Marsh Road |
| #047 | Jones River Dr #19 | | CB upstream | 623 | 809 | 4300 | 600 | 14000 | 19000 | 4 | 8 | 1,606 | 16,310 | 6 | 1165 | 530 | 5,381 | 1,980 | #047 | Jones River Dr #19 |
| #047 | Jones River Dr #19 Dup | | | | 809 | | 320 | | 28000 | | 10 | | | | | | | | #047 | Jones River Dr #19 Dup |
| #047B | Jones River Dr #5 | 1 | CB upstream | 635 | 819 | 2500 | 47000 | 15000 | 80000 | 6 | 12 | 10,840 | 34,641 | 9 | 2568 | 7,883 | **25,193** | 6,545 | #047B | Jones River Dr #5 |
| #195 | Landing @JRWA | | CB upstream | 605 | 830 | 6500 | 6500 | 7500 | 12000 | 24 | 22 | 6,500 | 9,487 | 23 | 3403 | 6,264 | 9,143 | **22,166** | #195 | Landing @JRWA |
| | Landing @JRWA Dup. | | | 605 | | 4100 | | 6800 | | 14 | | | | | | | | | | Landing @JRWA Dup. |
| #197 | Landiing behind Substation | | CB upstream | 705 | 841 | 7600 | 1800 | 18000 | 16000 | 10 | 4 | 3,699 | 16,971 | 7 | 2406 | 2,520 | 11,563 | 4,770 | #197 | Landiing behind Substation |
| #198 | Landing @Play. DMH | | in DMH | 827 | 853 | 270 | 10 | 6100 | 120 | 24 | 4 | 52 | 856 | 14 | | | | 0 | #198 | Landing @Play. DMH |
| #198 | Landing @Play. DMH Dup | | | | 854 | | 10 | | 100 | | 6 | | | | | | | | #198 | Landing @Play. DMH Dup |
| #043 | Maple St @ Stony Brook | | Outfall | 756 | 909 | 9000 | 4900 | 27000 | 15000 | 30 | 36 | 6,641 | 20,125 | 33 | 2284 | 4,295 | 13,017 | **21,345** | #043 | Maple St @ Stony Brook |
| #193 | Park St. in Channel | | in Stream | 736 | 919 | 680 | 790 | 780 | 3000 | 10 | 24 | 733 | 1,530 | 17 | 1590 | 330 | 689 | 7,655 | #193 | Park St. in Channel |
| | Park St. in Channel Dup. | | | 736 | | 640 | | 500 | | 6 | | | | | | | | | | Park St. in Channel Dup. |
| #051A | Riverside Drive | | CB upstream | 808 | 930 | 2900 | 4300 | 20000 | 77000 | 6 | 26 | 3,531 | 39,243 | 16 | 4437 | 4,437 | **49,311** | 20,105 | #051A | Riverside Drive |
| Mass DOT 1 | East of Rte. 3 Bridge | | Outfall | 905 | 1020 | 3600 | 2100 | 4600 | 2900 | 4 | 30 | 2,750 | 3,652 | 16 | | | | | Mass DOT 1 | East of Rte. 3 Bridge |
| Mass DOT 2 | L. Knife Outfall | | Outfall | 920 | 1012 | 4000 | 2700 | 26000 | 13000 | 20 | 44 | 3,286 | 18,385 | 32 | | | | | Mass DOT 2 | L. Knife Outfall |
| | | | | | AVERAGE | 12,323 | 5,774 | 13,399 | 26,181 | 14 | 20 | 5,417 | 16,962 | 17 | | 3,675 | 11,568 | 8,861 | AVERAGE | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | POLLUTANT LEVEL | | BAY PROXIMITY | | | | | | |
| | | | | | | Sept/Oct | | Sept/Oct | | Sept/Oct | | | Fecal Units | Entero. Units | CONSTRUCT. | | | RANK | | |
| | | | #59 | Shore Drive | | 4.2 | | 0.4 | | 0.7 | | | 3 | 3 | 5 | 3 | 14 | | #59 | Shore Drive |
| | | 2 | **Paved Swale #4** | **Delano Ave** | | 8.3 | | 0.5 | | 3.0 | | | 4 | 5 | 5 | 3 | **17** | 2 | **Paved Swale #4** | **Delano Ave** |
| | | 4 | **#041A** | **Town Ld'g-River Street** | | 2.0 | | 0.1 | | 1.0 | | | 4 | 3 | 5 | 4 | **16** | 4 | **#041A** | **Town Ld'g-River Street** |
| | | | #041B | Bay Farm Road | | 22.7 | | 2.9 | | 0.5 | | | 1 | 1 | 5 | 4 | 11 | | #041B | Bay Farm Road |
| | | 2 | **#041** | **Marsh Road** | | 33.3 | | 0.5 | | 0.4 | | | 5 | 4 | 4 | 4 | **17** | 2 | **#041** | **Marsh Road** |
| | | | #047 | Jones River Dr #19 | | 7.2 | | 0.7 | | 0.5 | | | 1 | 2 | 3 | 5 | 11 | | #047 | Jones River Dr #19 |
| | | 1 | **#047B** | **Jones Rive Dr #5** | | 0.1 | | 0.2 | | 0.5 | | | 5 | 5 | 3 | 5 | **18** | 1 | **#047B** | **Jones Rive Dr #5** |
| | | | #195 | Landing @JRWA | | 1.0 | | 0.6 | | 1.1 | | | 5 | 3 | 2 | 3 | 13 | | #195 | Landing @JRWA |
| | | | #197 | Landiing behind Substation | | 4.2 | | 1.1 | | 2.5 | | | 2 | 4 | 2 | 2 | 10 | | #197 | Landiing behind Substation |
| | | | #198 | Landing @Play. DMH | | 27.0 | | 50.8 | | 6.0 | | | 1* | 1* | | | | | #198 | Landing @Play. DMH |
| | | | #043 | Maple St @ Stony Brook | | 1.8 | | 1.8 | | 0.8 | | | 3 | 3 | 2 | 3 | 11 | | #043 | Maple St @ Stony Brook |
| | | | #193 | Park St. in Channel | | 0.9 | | 0.3 | | 0.4 | | | 1 | 1 | 2 | 4 | 8 | | #193 | Park St. in Channel |
| | | | #051A | Riverside Drive | | 0.7 | | 0.3 | | 0.2 | | | 3 | 5 | 1 | 5 | 14 | | #051A | Riverside Drive |
| | | | Mass DOT 1 | East of Rte. 3 Bridge | | 1.7 | | 1.6 | | 0.1 | | | * = absence of ff values moot | | | | | | Mass DOT 1 | East of Rte. 3 Bridge |
| | | | Mass DOT 2 | L. Knife Outfall | | 1.5 | | 2.0 | | 0.5 | | | 1-5 with 5 being worst | | | | | | Mass DOT 2 | L. Knife Outfall |

Working from the data shown on Table 3, ATP performed an analysis to determine which of the Town-controlled outfalls represents the greatest measurable threat to the shellfish areas in Kingston Bay at the mouth of the Jones River. A mass balance was performed for each outfall using the three laboratory measured parameters selected for the study (geometric mean or arithmetic average, as appropriate) and multiplying each by the "first flush" volume described earlier. The results are shown on Table 3 and reproduced below as Table 4.

Table 4
Mass Balance Results

| MASS BALANCE | | | |
|---|---|---|---|
| $x10^6$ | $x10^6$ | $x10^3$ | SAMPLE ID |
| Fecal Units | Entero. Units | TSS: mg | |
| | | | |
| 2,912 | 7,705 | 11,889 | #59 |
| 6,039 | 18,249 | 7,309 | Paved Swale #4 |
| **9,692** | 15,735 | 10,626 | #041A |
| 219 | 1,206 | 6,270 | #041B |
| **9,995** | 16,321 | 12,262 | #041 |
| 530 | 5,381 | 1,980 | #047 |
| 7,883 | **25,193** | 6,545 | #047B |
| 6,264 | 9,143 | **22,166** | #195 |
| 2,520 | 11,563 | 4,770 | #197 |
| 4,295 | 13,017 | **21,345** | #043 |
| 330 | 689 | 7,655 | #193 |
| 4,437 | **49,311** | 20,105 | #051A |

Viewing Table 4, the greatest mass of fecal coliform units was measured at outfall #041 (Marsh Road) and outfall #041A (Town Landing) with 9,995 million units and 9,692 million units, respectively. The greatest mass of enterococci bacteria were at outfall #047B, and at outfall #051A (Riverside Drive) with 25,193 million units and 49,311 million units, respectively. The greatest volume of total suspended solids was observed at outfall #195 (Jones River Watershed Assoc. Landing) and the Maple Street outfall (#043 with 22,166 grams and 21,345 grams, respectively. The respective average values were 3,675 million units fecal, 11,568 million units enterococci, and 8,861 grams TSS.

## IV. SITE SELECTION FOR CONCEPTUAL AND PRELIMINARY DESIGN

In an effort to whittle down the number of outfalls to be subject to preliminary design, ATP developed a relatively simple matrix analysis incorporating four parameters: Pollutant Level (mass fecal units and mass enterococci units); Proximity to Kingston Bay; and Constructibility. Constructibility refers to the probability that a subsurface leaching system can be built with volume suitable to manage the first flush and is based, in part, on the apparent public land available and soil characteristics as gleaned from the most recent NRCS mapping. Soil location and types are summarized in Table 5 below and shown, in part, on Figure 1.

| | | | | | **Table 5 - NRCS Soil Characteristics** | | |
|---|---|---|---|---|---|---|---|
| | Outfall | First | Distance | River | | | Depth to |
| No. | ID | Flush | to River | Mile | Predominant | Hydrologic/Drainage Char. | Water Table |
| | | CF | Feet | to Mouth | Soil | | River |
| | | | | | | | |
| 1 | #059 | 2099 | 0 | 0.00 | 635C, Canton, urban land, rock outcrop | B/ | >200 |
| | | | | | 309B, Moshup loam, v. stony | C/Moderately well drained | 61 (2 ft) |
| 2 | #041A | 2622 | 0 | 0.19 | 602B, Urban land | | >200 |
| | | | | | 341B, Broadbrook, vf sandy loam | C/Well drained | 61 (2 ft) |
| | | | | | 420C, Canton, vf sandy loam | B/Well drained | >200 |
| 3 | #041B | 1476 | 0 | 0.09 | 341B, Broadbrook, vf sandy loam | C/Well drained | 61 (2 ft) |
| 4 | #041 | 2547 | 0 | 0.32 | 341B, Broadbrook, vf sandy loam | C/Well drained | 61 (2 ft) |
| 5 | #047 | 1162 | 100 | 0.91 | 420C, Canton, vf sandy loam | B/Well drained | >200 |
| 6 | #047B | 2568 | 400 | 1.34 | 256A, Deerfield, fine sand | B/Moderately well drained | 69 (2'-3") |
| | | | | | 316B, Scituate, gv,sdy loam | C/Moderately well drained | 38 (15”) |
| 7 | #051A | 4437 | 200 | 2.08 | 254B, Merrimac sandy loam | A/Somewhat excessively drained | >200 |
| 8 | #195 | 3403 | 0 | 1.63 | 602B, Urban land | | >200 |
| | | | | | 252B, Carver coarse sand | A/excessively drained | >200 |
| 9 | #197 | 2406 | 0 | 1.70 | 254B, Merrimac sandy loam | A/Somewhat excessively drained | >200 |
| 10 | #043 | 2284 | 500 | 1.86 | 602B, Urban land | | >200 |
| | | | | | 37A, Massosoit, Mashpee complex | D/Poorly drained | 0 |
| 11 | PS #4 | 1613 | 0 | 0.19 | 635C, Canton, urban land, rock outcrop | B/ | >200 |
| 12 | #198 | | 0 | 1.74 | 254B, Merrimac sandy loam | A/Somewhat excessively drained | >200 |
| 13 | #193 | 1590 | 1150 | 1.59 | 276A,223A Ninigret fs loam;Scio vfs loam | B/Moderately well drained | 56 |

Within the matrix, each outfall was assigned a value from one to five for each of the four parameters with 1 being not significant and 5 being significant. For constructibility, a value of 1 was given to sites deemed to pose significant construction hurdles while 5 was given to sites that appeared to be buildable with few complications (eg, absent tight soils or high groundwater). The individual scores were then added up with the highest value representing outfalls that should move forward to preliminary design. Table 6 below presents the scoring matrix, total value, and subsequent rank for the top four outfalls.

Table 6
Decision Matrix

| POLLUTANT LEVEL | | | | | | |
|---|---|---|---|---|---|---|
| Fecal Units | Entero. Units | BAY PROXIMITY | CONSTRUCT. | TOTAL | RANK | OUTFALL # |
| 3 | 3 | 5 | 3 | 14 | | #59 |
| 4 | 5 | 5 | 3 | **17** | 2 | **P. Swale #4** |
| 4 | 3 | 5 | 4 | **16** | 4 | **#041A** |
| 1 | 1 | 5 | 4 | 11 | | #041B |
| 5 | 4 | 4 | 4 | **17** | 2 | **#041** |
| 1 | 2 | 3 | 5 | 11 | | #047 |
| 5 | 5 | 3 | 5 | **18** | 1 | **#047B** |
| 5 | 3 | 2 | 3 | 13 | | #195 |
| 2 | 4 | 2 | 2 | 10 | | #197 |
| 1* | 1* | 2 | 3 | 7* | | #198 |
| 3 | 3 | 2 | 3 | 11 | | #043 |
| 1 | 1 | 2 | 4 | 8 | | #193 |
| 3 | 5 | 1 | 5 | 14 | | #051A |
| * = mass balance values not calculated | | | | | | |

As shown above in Table 6, outfall #047B (Jones River Dr. #5) is the highest ranking site. Outfall #041 (Marsh Road) and Paved Swale #4 (Delano Ave.) tied for second; while Outfall #041A (Town Landing at River Road) represents the fourth highest rank site. These four sites were subsequently subject to topographic survey and two selected by the Town for preliminary design; Paved Swale #4 on Delano Avenue and Outfall #041A at the Town Landing on River Road. The remaining sites (10) were subject to conceptual design.

## V. CONCEPTUAL DESIGNS

In an effort to begin the process of mitigating stormwater impacts, conceptual designs were developed for ten catchment areas. Using first flush volumes calculated and presented above, a site specific BMP system that would remove suspended solids and fecal coliform using infiltration systems, both surface and subsurface, was developed. System headworks were sized to hold 10% of the first flush volume for settling purposes. Consistent with the Massachusetts Stormwater Handbook, infiltration systems were sized using TR-55 analyses based upon the first flush (1" of runoff) which serves as the Required Water Quality Volume. The "Dynamic Field" method was used to determine system size based upon an estimate of permeability from the soils data gathered from NRCS sources. Technically, the "Simple Dynamic" system should be used absent field measured soils data, but it is anticipated that all sites will be subject to field investigation as the program goes forward where the "Dynamic Field" method will ultimately be used for final design.

Depending upon soil types and estimated depth to water table, surface and subsurface infiltration systems were analyzed. In shallow-to-groundwater areas, such as near to outfalls, vegetated swales, surface filtration systems, and rain gardens were proposed (Outfall #043, 193, 047B and 41B). Where first flush volumes were large, upgradient subsurface systems were selected for conceptual design to capture flow and minimize the footprint of surface systems (Outfalls 195, 041, 059). Subsurface systems were selected in locations where soils were permeable, groundwater was deemed to be at depth, and/or where space was tight (Outfall 047, 051A, 197. In some locations a network of existing catchbasins and drain manholes were worked into the conceptual design. (eg, Outfall 041) while elsewhere, no system existed apart from a simple catchbasin/outfall complex (eg, Outfall 043). Typical sedimentation units were comprised of drain manholes with 4' sumps and septic tanks ranging in size from 1000 gallons to 1500 gallons. Conceptual infiltration systems were predicated upon units manufactured by Cultec with varying heights and sizes. Surface filtration systems sometimes were proposed to be constructed using imported sand with underdrainage where soils were deemed not sufficiently permeable (eg, Outfall 043 and 195).

A single plan sheet was developed to illustrate the conceptual designs prepared. Sheet 1 depicts systems that serve all ten outfalls selected for future work. Based upon these conceptual designs, a materials quantity takeoff was performed and a construction cost estimate developed for each location. Construction costs were increased by 15% to cover contingencies and 25% to cover the cost of services for final design and construction inspection. Table 7 below presents a summary of the total construction costs based upon the ten Conceptual Designs. As shown, the total construction cost estimate for all systems on Sheet 1 is $556, 392.

TABLE 7
SUMMARY TABLE
TOTAL CONSTRUCTION COST ESTIMATE
from Conceptual Designs

| OUTFALL | COST |
|---|---|
| 41 | $62,991 |
| 041B | $32,459 |
| 43 | $9,056 |
| 47 | $55,071 |
| 047B | $44,649 |
| 051A | $117,314 |
| 59 | $83,008 |
| 193 | $7,547 |
| 195 | $80,299 |
| 197 | $63,998 |
| TOTAL COST | $556,392 |

## VI. PRELIMINARY DESIGNS

Based upon the matrix analysis results described above, outfalls on Delano Avenue (Paved Swale #4) and the Town Landing (Outfall #041A) were selected for preliminary design. Tasks to raise a design from "conceptual" to "preliminary" included a detailed topographic and utility survey plotted to 20-scale, and refined design to ensure clearance with existing watermains, sewage forcemains, and service connections. Two drawings were completed for the Preliminary Designs. Sheet 1 of 2 depicts the design for the Town Landing while Sheet 2 of 2 depicts the design for the paved swale on Delano Avenue. Since the catchment area contributing flow at the Town Landing is substantial, numerous BMP locations were identified and designed including systems on Loring Road at River Road, and a complex of systems at the Marsh Road/River Road intersection. No stormwater infrastructure exists at either location so all systems were designed to bypass flows in excess of the first flush along the street as flows currently do. [Note: The Town is currently considering improvements to the landing and the pier. With upgradient first flush flows proposed to be captured at Loring Road and Marsh Road, two small systems (a rain garden and a subsurface leaching system) have been developed near the pier itself to capture and treat the remaining first flush runoff].

Preliminary design at the paved swale on Delano Avenue is proposed to be comprised of a trench drain at the toe of the road, two 5' drain manholes with 4' sumps, and two 18' diameter rain gardens. The site is fairly tight with poor soils and narrow public land but it appears, based upon current understanding of property lines, that a rain garden of some configuration is possible on both sides of the proposed trench drain. Final design will ensure that, once the rain gardens are full, flows in excess of the first flush will pass over the trench drain and enter the Jones River as they currently do. The final design will also seek to manage any scour that might occur from the new system by specifying some combination of riprap and hardy vegetation down gradient.

Based on the preliminary designs shown on the two design sheets, a total construction cost estimate of $268,778 has been calculated for outfall 041A and paved swale #4. The total construction cost includes 10% for construction contingencies and 25% for services related to design and construction inspection. Table 8 below presents the total construction cost for outfalls already subject to Preliminary Design.

TABLE 8
SUMMARY TABLE
CONSTRUCTION COST ESTIMATE
from Preliminary Designs

| OUTFALL | COST |
|---|---|
| PS #4 | $50,442 |
| #041A | $218,336 |
| TOTAL COST | $268,778 |

Adding the results presented in Table 7 ad Table 8, the total construction cost estimate to mitigate all twelve outfalls is $825,170

# VII. CONCLUSIONS AND RECOMMENDATIONS

## CONCLUSIONS

1. "First Flush" volumes were calculated at 20 out of 21 catchment areas that contribute road runoff to the Jones River and Kingston Bay. The catchment areas ranged from immediately adjacent to Kingston Bay and the mouth of the Jones River to an outfall approximately 1.86 miles upstream. Two outfalls were into brooks contributing flow to Jones River.

2. Water quality sampling at end of pipe or immediate upstream structure (eg, catchbasin) during the first flush of two storm events document elevated levels of bacteria concentrations (fecal and enterococci) and mass balance values. The 15-location sampling program resulted in the identification of 12 catchment areas to be subject to conceptual design or preliminary engineering.

3. Conceptual design has been completed on ten catchment areas. The total construction cost, including final engineering design, construction, and construction inspection for all ten locations is $556,392.

4. Preliminary design has been completed on two catchment areas. The total construction cost, including final engineering design, construction, and construction inspection for the two locations is $268,778.

5. The estimated cost to mitigate all catchment discharges is $825,170.

## RECOMMENDATIONS

1. Prepare an application under the Coastal Pollutant Remediation (CPR) Grant Program in the Fall of 2012 for FY'13 funding to initiate construction of BMP systems that mitigate pollution from stormwater discharges at Delano Avenue and the Town Landing into the Jones River.

2. To the extent possible, when improvements to the Pier are developed, incorporate the design of stormwater BMP improvements shown on Sheet 1 of 2 to complement proposed upland BMP measures.

3. Obtain the best information available describing property line locations at the Delano Ave/ Grandview Ave intersection in anticipation of constructing two surface infiltration systems.

4. Consider using force account to implement mitigation measures at outfall #043 (Maple Street) and outfall #193 (Park Street) where simple vegetated swales are the BMP of choice.

# APPENDIX

# KINGSTON BAY

Maple Street
Brook
Stoney
Maple Street
#043
Geometric Mean:
Fecal = 6,641
Entero = 20,125
320A
602B
602B
37A
37A
256B
256B
252B
ROUTE 3
Park Street
Landing Road
276A
223A
#193
Geometric Mean:
Fecal = 733
Entero = 1,530
River Street
#195
Geometric Mean:
Fecal = 6,500
Entero = 9,487
602B
#196 - Substation
MDOT#1
Geometric Mean:
Fecal = 2,750
Entero = 3,652
Geometric Mean:
Fecal = 52
Entero = 856
#198
Sampling
DMH
#197 - Road
Geometric Mean:
Fecal = 3,699
Entero = 16,971
254B
253E
#198
Upland
Landing Road
Riverside Drive
254C
254B
Geometric Mean:
Fecal = 3,531
Entero = 39,243
#051A
MDOT#2
Geometric Mean:
Fecal = 3,286
Entero = 18,385
ROUTE 3
316B
River Street
256A
#047B
Geometric Mean:
Fecal = 3,531
Entero = 39,243
420C
Jones
Marsh Road
341B
Bay Farm Road
Geometric Mean:
Fecal = 524
Entero = 2,886
#041B
Town
Landing
#041A
Geometric Mean:
Fecal = 9,121
Entero = 14,809
602B
341B
Geometric Mean:
Fecal = 13,856
Entero = 22,627
#041
51A
River
Drive
#047
Geometric Mean:
Fecal = 1,606
Entero = 16,310
420C
#057A
JONES
RIVER
Geometric Mean:
Fecal = 13,221
Entero = 39,850
Paved Swale #4
Paved Swale #3
Paved Swale #2
Paved Swale #1
#060
#059
Geometric Mean:
Fecal = 4,899
Entero = 12,961
Adam Ave.
Drew Ave.
Seaver Ave.
Cobb Ave.
Holmes Ave.
Shore Drive
635C
635C
Delano Street
Cedar Ln
Page Ave
309B
453B
Howlands Lane

NOTE: Base Plan developed from
Storm Drain Mapping, 2008,
by Environmental Partners, Quincy, MA

**LEGEND**

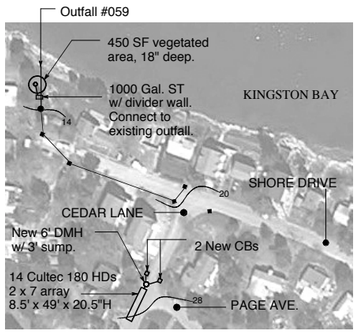
#041B Outfall ID No.
Outfall Sampled
Outfall Not Sampled
Paved Swale Not Sampled
Paved Swale Sampled
Catchment Limit
420C Soil Type
Soil Limit
Fecal and entero values expressed as cfu/100ml

400 200 100 0 200 600
1 inch = 200ft.
GRAPHIC SCALE

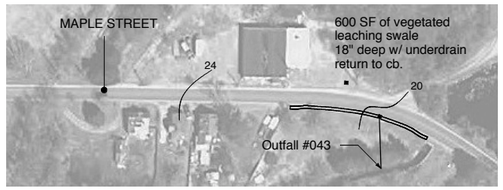
**FIGURE 1**
**CATCHMENT AREAS**
**FOR**
**KINGSTON BAY / JONES RIVER**
**KINGSTON, MA**

*A T P ENVIRONMENTAL*
*77 SHEFFIELD ROAD*
*MELROSE, MA 02176*
*781-662-6033*

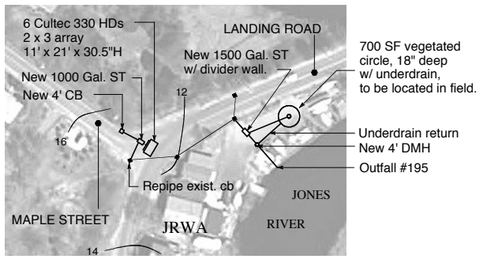
DATE: DECEMBER 21, 2011
PROJ. NO. 11-222




Outfall #059




Outfall #043

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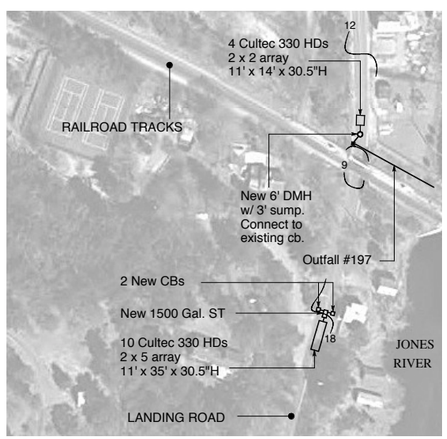
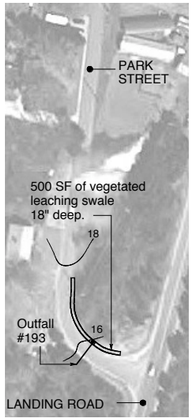
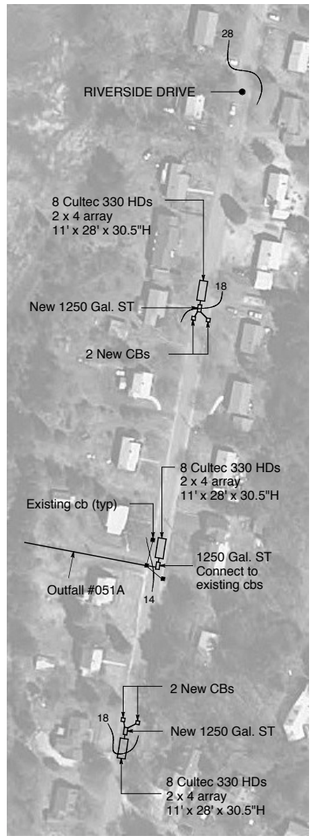


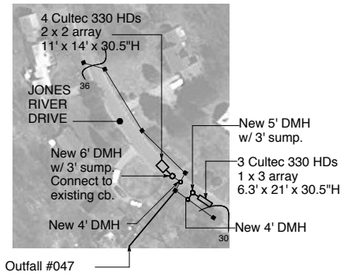

Outfall #197



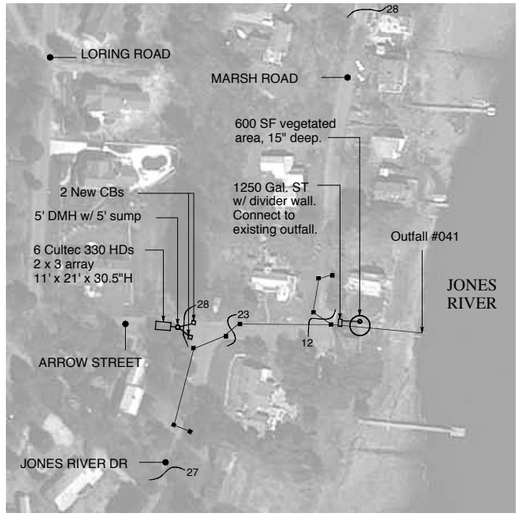

Outfall #193



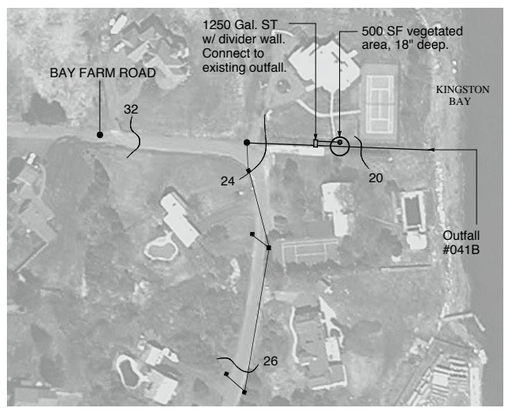

Outfall #051A



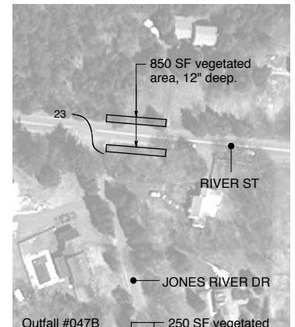

Outfall #047




Outfall #041




Outfall #041B




Outfall #047B

## LEGEND

- 16 — Contour
- ● — Existing DMH
- ■ — Existing catchbasin
- ▫ — Proposed catchbasin
- ——— Existing drain line
- ——— Proposed drain line
- □ — Proposed structure
- Proposed vegetated swale

GENERAL NOTES

1. Existing conditions based upon field inspections by ATP Environmental, supplemented by information provided by the Kingston Conservation agent.

2. Screened background is presented at 100-Scale based upon mapping obtained courtesy of the Massachusetts Geographic Information System.

3. Size of existing and proposed structures is approximate.

4. The proposed facilities were used to develop an estimate of construction cost.

5. Figure 1 serves as the source for location of all outfalls depicted on this Sheet.

100 0 100 200 400

( IN FEET )
1 inch = 100 ft.

# CONCEPTUAL DESIGNS

FOR

## KINGSTON BAY AT JONES RIVER

KINGSTON, MA

*A T P ENVIRONMENTAL*
*77 SHEFFIELD ROAD*
*MELROSE, MA 02176*
*781-662-6033*

DATE: DECEMBER 14, 2011 SHEET NO: 1 PROJ. NO. 11-222

GENERAL NOTES

1. All vessels including, but not limited to catchbasins, drain manholes, leaching structures, septic tanks, sleeves, and vessel covers, shall be designed and built for H-20 loading. Unless otherwise indicated, vessels shall be set on a 6" thick layer of 3/4" minus crushed stone compacted to 95% (MDPW M2.01.4) overlying a firm, stable subbase.

2. Existing conditions and topography obtained per field survey performed November 21, 2011 by A T P ENVIRONMENTAL.

3. Topographic survey completed based on USGS 1929 datum from magnetic nail set in River Street Pier by Grady Consulting, Inc., Kingston, MA, 2002: Elev. 7.76

4. All new pipe is to be HDPE unless otherwise shown. Pipe shall be set atop bed 12" deep (min) comprised of 1" (max) stone backfilled to spring line. Maximum trench width shall not exceed five (5) feet.

5. An appropriately sized oil trap hood (Snout) shall be installed where noted on the plans.

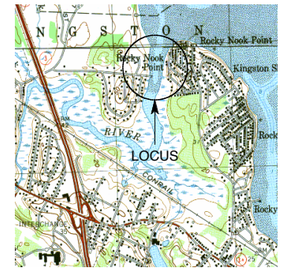
6. All new drain manholes to be fitted with catchbasin grates
   a) Frame and grate to be Le Baron LA 248-2.
   b) Drain manhole hood to be BMP "Snout" or equivlent.
   c) Set frame in full bed of mortar. Bricks (3-5 courses) may be used for grade adjusments.
   d) Mortar all joints
   e) Provide "V" openings for pipes with 2" clearance outside op pipe.
   f) Provide min. of 0.12 sq. in. of steel per vertical foot and place per AASHTO M199.
   g) Construction material for structure to consist of concrete block set in mortar or precast concrete with a 28 day compressive strength of 4000 psi.

7. Contractor must notify "DIGSAFE" at 1-888-344-7233 at least 72 hours prior to construction.

8. All new drain manholes shall have risers with frame and grate to grade as shown on plans.

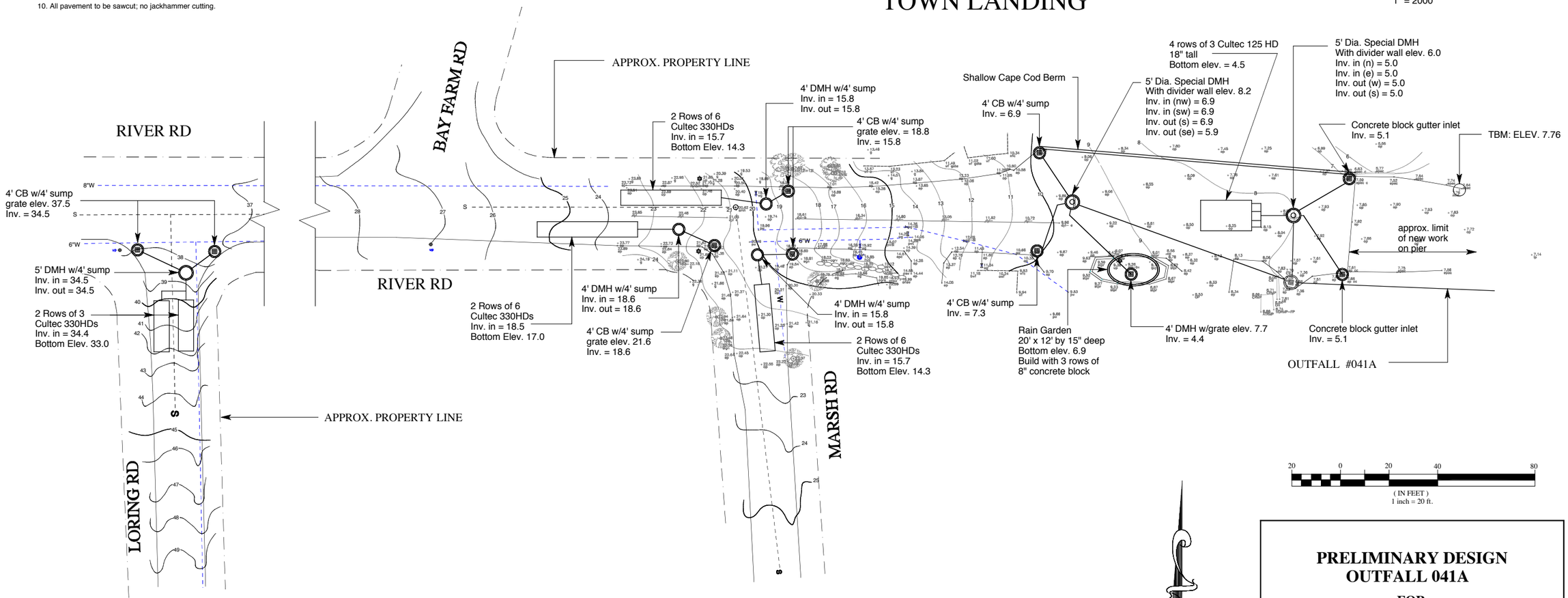
9. Contractor shall comply with all applicable Federal, State, and local trenching requirements.

10. All pavement to be sawcut; no jackhammer cutting.




PROJECT LOCUS
1" = 2000'

# TOWN LANDING



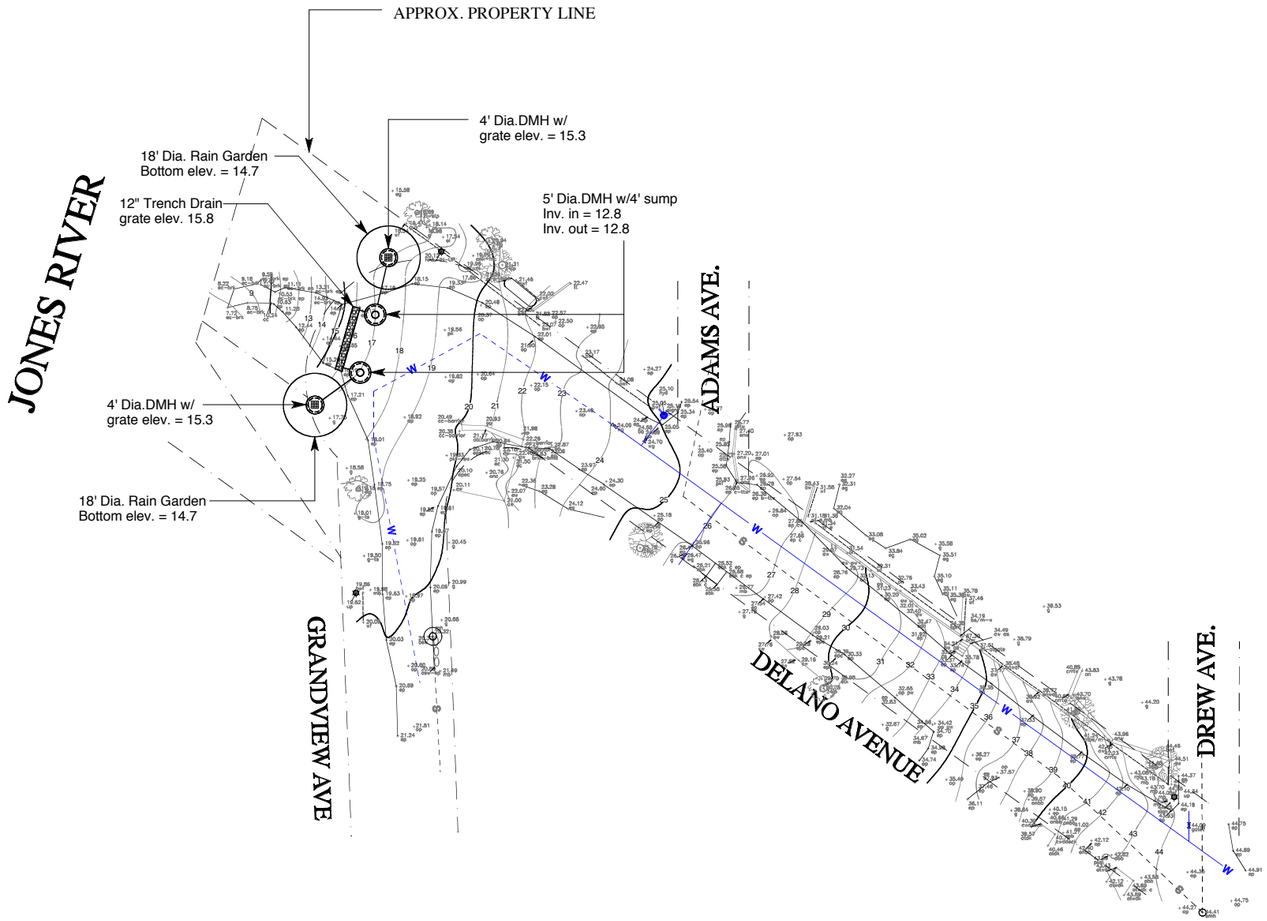

20 0 20 40 80
( IN FEET )
1 inch = 20 ft.

**PRELIMINARY DESIGN**
**OUTFALL 041A**
**FOR**
**TOWN LANDING**

**KINGSTON, MA**

*A T P ENVIRONMENTAL*
*77 SHEFFIELD ROAD*
*MELROSE, MA 02176*
*781-662-6033*

DATE: DECEMBER 27, 2011 SHEET NO: 1 of 2 PROJ. NO. 11-222




20 0 20 40 80

( IN FEET )
1 inch = 20 ft.

# PRELIMINARY DESIGN
# PAVED SWALE #4

**FOR**

## DELANO STREET

**KINGSTON, MA**

*A T P ENVIRONMENTAL*
*77 SHEFFIELD ROAD*
*MELROSE, MA 02176*
*781-662-6033*

DATE: DECEMBER 27, 2011 SHEET NO: 2 of 2 PROJ. NO. 11-222

CONSTRUCTION COST ESTIMATE

CONCEPTUAL DESIGNS

SITE NO.

| ITEMS | UNITS | UNIT PRICE | 41 | 041B | 43 | 47 | 047B | 051A | 59 | 193 | 195 | 197 | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4' DMH | EA | $3000 | | 1 | | 2 | 2 | | | | | | 5 | 4' DMH |
| 5' DMH | EA | $5000 | 1 | | | 1 | | | | | | | 2 | 5' DMH |
| 6' DMH | EA | $7000 | | | | 1 | | | 1 | | | 1 | 3 | 6' DMH |
| 1000 GAL ST | EA | $9000 | | | | | | | 1 | | 1 | | 2 | 1000 GAL ST |
| 1250 GAL ST | EA | $9500 | 1 | 1 | | | | 3 | | | | | 5 | 1250 GAL ST |
| 1500 GAL ST | EA | $10000 | | | | | | | | | 1 | 1 | 2 | 1500 GAL ST |
| LEACH SWALE | SF | $10 | | | 600 | | | | | 500 | | | 1100 | LEACH SWALE |
| LEACH AREA | SF | $12 | | 500 | | | 1100 | | 450 | | 700 | | 2750 | LEACH AREA |
| PIPE REWORK | EA | $400 | | 1 | | 2 | 1 | | 1 | | 2 | | 7 | PIPE REWORK |
| ALL PIPE | LF | $45 | 80 | 40 | | 40 | 30 | 100 | 40 | | 120 | | 450 | ALL PIPE |
| PLANTING | SF | $0.50 | | 500 | 600 | 0 | 1100 | 0 | 450 | 500 | 700 | 0 | 3850 | PLANTING |
| CULTEC 330 | EA | $1100 | 6 | | | 7 | | 24 | | | 6 | 14 | 57 | CULTEC 330 |
| CULTEC 180 | EA | $800 | | | | | 6 | | 14 | | | | 20 | CULTEC 180 |
| CATCHBASIN | EA | $3500 | 3 | | | | | 4 | 3 | | 2 | 2 | 14 | CATCHBASIN |
| 12" TRENCH DR | LF | $300 | | | | | | | | | | | 0 | 12" TRENCH DR |
| REPAVEMENT | SY | $45 | 100 | 0 | | 150 | 60 | | 180 | | 90 | | 580 | REPAVEMENT |
| F&G / R&C | EA | $600 | 4 | 2 | | 4 | 2 | 7 | 4 | | 4 | 4 | 31 | F&G / R&C |
| MH CB HOODS | EA | $430 | 4 | 1 | | 2 | 2 | 7 | 4 | | 2 | 4 | 26 | MH CB HOODS |
| MODIFY DMH | EA | $1000 | | | | | | | | | | | 0 | MODIFY DMH |
| MODIFY CB | EA | $1000 | | | | | | 1 | | | 1 | 1 | 3 | MODIFY CB |
| SUBTOTAL COST | | | $43820 | $22580 | $6300 | $38310 | $31060 | $81610 | $57745 | $5250 | $55860 | $44520 | $387,055 | SUBTOTAL COST |
| CONTINGENCY (15%) | | 15.00% | $6573 | $3387 | $945 | $5747 | $4659 | $12242 | $8662 | $788 | $8379 | $6678 | $58,058 | CONTINGENCY (10%) |
| ENGR & INSPECTION (25%) | | 25.00% | $12598 | $6492 | $1811 | $11014 | $8930 | $23463 | $16602 | $1509 | $16060 | $12800 | $111278 | ENGR & INSPECTION (25%) |
| TOTAL COST | | | $62991 | $32459 | $9056 | $55071 | $44649 | $117314 | $83008 | $7547 | $80299 | $63998 | $556,392 | TOTAL COST |
| 4' DMH | | | $0 | $3,000 | $0 | $6,000 | $6,000 | $0 | $0 | $0 | $0 | $0 | $15,000 | 4' DMH |
| 5' DMH | | | $5,000 | $0 | $0 | $5,000 | $0 | $0 | $0 | $0 | $0 | $0 | $10,000 | 5' DMH |
| 6' DMH | | | $0 | $0 | $0 | $7,000 | $0 | $0 | $7,000 | $0 | $0 | $7,000 | $21,000 | 6' DMH |
| 1000 GAL ST | | | $0 | $0 | $0 | $0 | $0 | $0 | $9,000 | $0 | $9,000 | $0 | $18,000 | 1000 GAL ST |
| 1250 GAL ST | | | $9,500 | $9,500 | $0 | $0 | $0 | $28,500 | $0 | $0 | $0 | $0 | $47,500 | 1250 GAL ST |
| 1500 GAL ST | | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $10,000 | $10,000 | $20,000 | 1500 GAL ST |
| LEACH SWALE | | | $0 | $0 | $6,000 | $0 | $0 | $0 | $0 | $5,000 | $0 | $0 | $11,000 | LEACH SWALE |
| LEACH AREA | | | $0 | $6,000 | $0 | $0 | $13,200 | $0 | $5,400 | $0 | $8,400 | $0 | $33,000 | LEACH AREA |
| PIPE REWORK | | | $0 | $400 | $0 | $800 | $400 | $0 | $400 | $0 | $800 | $0 | $2,800 | PIPE REWORK |
| ALL PIPE | | | $3,600 | $1,800 | $0 | $1,800 | $1,350 | $4,500 | $1,800 | $0 | $5,400 | $0 | $20,250 | ALL PIPE |
| PLANTING | | | $0 | $250 | $300 | $0 | $550 | $0 | $225 | $250 | $350 | $0 | $1,925 | PLANTING |
| CULTEC 330 | | | $6,600 | $0 | $0 | $7,700 | $0 | $26,400 | $0 | $0 | $6,600 | $15,400 | $62,700 | CULTEC 330 |
| CULTEC 180 | | | $0 | $0 | $0 | $0 | $4,800 | $0 | $11,200 | $0 | $0 | $0 | $16,000 | CULTEC 180 |
| CATCHBASIN | | | $10,500 | $0 | $0 | $0 | $0 | $14,000 | $10,500 | $0 | $7,000 | $7,000 | $49,000 | CATCHBASIN |
| 12" TRENCH DR | | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | 12" TRENCH DR |
| REPAVEMENT | | | $4,500 | $0 | $0 | $6,750 | $2,700 | $0 | $8,100 | $0 | $4,050 | $0 | $26,100 | REPAVEMENT |
| F&G / R&C | | | $2,400 | $1,200 | $0 | $2,400 | $1,200 | $4,200 | $2,400 | $0 | $2,400 | $2,400 | $18,600 | F&G / R&C |
| MH CB HOODS | | | $1,720 | $430 | $0 | $860 | $860 | $3,010 | $1,720 | $0 | $860 | $1,720 | $11,180 | MH CB HOODS |
| MODIFY DMH | | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | MODIFY DMH |
| MODIFY CB | | | $0 | $0 | $0 | $0 | $0 | $1,000 | $0 | $0 | $1,000 | $1,000 | $3,000 | MODIFY CB |
| SUBTOTAL | | | $43820 | $22580 | $6300 | $38310 | $31060 | $81610 | $57745 | $5250 | $55860 | $44520 | $387,055 | SUBTOTAL |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | CONSTRUCTION COST ESTIMATE | | | | | |
| | | PRELIMINARY DESIGNS | | | | | |
| | | | | | | | |
| | | | Public | Town | | TOTALS | |
| ITEMS | UNITS | UNIT PRICE | Swale #4 | Landing | | | |
| | | | | | | | |
| 4' DMH | EA | $3000 | | 4 | | 4 | |
| 5' DMH | EA | $5000 | 2 | 2 | | 4 | |
| 6' DMH | EA | $7000 | | | | 0 | |
| 1000 GAL ST | EA | $9000 | | | | 0 | |
| 1250 GAL ST | EA | $9500 | | | | 0 | |
| 1500 GAL ST | EA | $10000 | | | | 0 | |
| LEACH SWALE | SF | $10 | | | | 0 | |
| LEACH AREA | SF | $12 | 510 | | | 510 | |
| PIPE REWORK | EA | $400 | | | | 0 | |
| ALL PIPE | LF | $45 | 60 | 470 | | 530 | |
| PLANTING | SF | $0.50 | 510 | 100 | | 610 | |
| CULTEC 330 | EA | $1100 | | 22 | | 22 | |
| CULTEC 180 | EA | $800 | | 12 | | 12 | |
| CATCHBASIN | EA | $3500 | 2 | 9 | | 11 | |
| 12” TRENCH DR | LF | $300 | 20 | | | 20 | |
| REPAVEMENT | SY | $45 | 30 | 700 | | 730 | |
| F&G / R&C | EA | $600 | 4 | 16 | | 20 | |
| MH CB HOODS | EA | $430 | 2 | 13 | | 15 | |
| MODIFY DMH | EA | $1000 | | | | 0 | |
| MODIFY CB | EA | $1000 | | 1 | | 1 | |
| CAPE COD BERM | LF | $20 | | 130 | | 130 | |
| | | | | | | | |
| SUBTOTAL COST | | | $36685 | $158790 | | $195,475 | |
| CONTINGENCY (10%) | | 10.00% | $3669 | $15879 | | $19,548 | |
| ENGR & INSPECTION (25%) | | 25.00% | $10088 | $43667 | | $53,756 | |
| TOTAL COST | | | $50442 | $218336 | | $268,778 | |
| | | | | | | | |
| | | | | | | | |
| 4' DMH | | | $0 | $12,000 | | $12,000 | |
| 5' DMH | | | $10,000 | $10,000 | | $20,000 | |
| 6' DMH | | | $0 | $0 | | $0 | |
| 1000 GAL ST | | | $0 | $0 | | $0 | |
| 1250 GAL ST | | | $0 | $0 | | $0 | |
| 1500 GAL ST | | | $0 | $0 | | $0 | |
| LEACH SWALE | | | $0 | $0 | | $0 | |
| LEACH AREA | | | $6,120 | $0 | | $6,120 | |
| PIPE REWORK | | | $0 | $0 | | $0 | |
| ALL PIPE | | | $2,700 | $21,150 | | $23,850 | |
| PLANTING | | | $255 | $50 | | $305 | |
| CULTEC 330 | | | $0 | $24,200 | | $24,200 | |
| CULTEC 180 | | | $0 | $9,600 | | $9,600 | |
| CATCHBASIN | | | $7,000 | $31,500 | | $38,500 | |
| 12” TRENCH DR | | | $6,000 | $0 | | $6,000 | |
| REPAVEMENT | | | $1,350 | $31,500 | | $32,850 | |
| F&G / R&C | | | $2,400 | $9,600 | | $12,000 | |
| MH CB HOODS | | | $860 | $5,590 | | $6,450 | |
| MODIFY DMH | | | $0 | $0 | | $0 | |
| MODIFY CB | | | $0 | $1,000 | | $1,000 | |
| CAPE COD BERM | | | $0 | $2,600 | | $2,600 | |
| SUBTOTAL | | | $36685 | $158790 | | $195,475 | |

G & L Laboratories

✦ Water Analysis ✦ Food/Seafood Analysis ✦ Metals/Chemical Analysis ✦ Microbiological Testing

246 Arlington Street, Quincy, MA 02170 Tel: (617) 328-3663 Fax: (617) 472-0706

# REPORT

September 30, 2011

**Lab. I. D. # 58104**

Attn: Ms. Maureen Thomas
Kingston Recreation Dept.
26 Evergreen St.
Kingston, MA 02364

**Sample Received Date/Time:** 9/22/11, 10:45 AM
**Sample Received Temperature:** N/A
**Sample Identification:** Thirty-six (36) storm water samples labeled:

1. #59 (Collected Date/Time: 9/22/11, 5:15 AM) - Shore Drive
2. #59 (Collected Date/Time: 9/22/11, 5:16 AM) - Shore
3. #59 (Collected Date/Time: 9/22/11, 5:15 AM) - Shore
4. #59 (Collected Date/Time: 9/22/11, 5:16 AM) - Shore
5. DPS1 (Collected Date/Time: 9/22/11, 5:05 AM) - Delano Paved Swale
6. DPS1 (Collected Date/Time: 9/22/11, 5:05 AM) "
7. #041A (Collected Date/Time: 9/22/11, 5:34 AM) - River St. @ Town Landing
8. #041A (Collected Date/Time: 9/22/11, 5:36 AM) "
9. #041B (Collected Date/Time: 9/22/11, 5:44 AM) Bay Farm
10. #041B (Collected Date/Time: 9/22/11, 5:45 AM) "
11. #041 (Collected Date/Time: 9/22/11, 6:42 AM) - Marsh Rd.
12. #041 (Collected Date/Time: 9/22/11, 6:43 AM) "
13. #047 (Collected Date/Time: 9/22/11, 6:23 AM) Jones R. Dr. @ #19
14. #047 (Collected Date/Time: 9/22/11, 6:25 AM) "
15. #047B (Collected Date/Time: 9/22/11, 6:35 AM) Jones R. Dr @ #5
16. #047B (Collected Date/Time: 9/22/11, 6:36 AM) "
17. #195 (Collected Date/Time: 9/22/11, 6:05 AM) Landing @ JRWA
18. #195 (Collected Date/Time: 9/22/11, 6:07 AM) "
19. #195 (Collected Date/Time: 9/22/11, 6:05 AM) "
20. #195 (Collected Date/Time: 9/22/11, 6:07 AM) "
21. #197 (Collected Date/Time: 9/22/11, 7:05 AM) Landing behind substation
22. #197 (Collected Date/Time: 9/22/11, 7:06 AM) "
23. #198 (Collected Date/Time: 9/22/11, 8:27 AM) Landing @ playground DMH
24. #198 (Collected Date/Time: 9/22/11, 8:28 AM) "
25. #043 (Collected Date/Time: 9/22/11, 7:56 AM) Maple St. Stony Brook
26. #043 (Collected Date/Time: 9/22/11, 7:57 AM) "
27. #193 (Collected Date/Time: 9/22/11, 7:36 AM) Park St. in channel
28. #193 (Collected Date/Time: 9/22/11, 7:40 AM) "
29. #193 (Collected Date/Time: 9/22/11, 7:36 AM) "
30. #193 (Collected Date/Time: 9/22/11, 7:40 AM) "
31. #051A (Collected Date/Time: 9/22/11, 8:08 AM) - Riverside Dr
32. #051A (Collected Date/Time: 9/22/11, 8:09 AM) "
33. Mass Dot #1 (Collected Date/Time: 9/22/11, 9:05 AM) - East of Rte 3. bridge
34. Mass Dot #1 (Collected Date/Time: 9/22/11, 9:06 AM) "
35. Mass Dot #2 (Collected Date/Time: 9/22/11, 9:20 AM) - Licnite outfall
36. Mass Dot #2 (Collected Date/Time: 9/22/11, 9:20 AM) "

**Sampling Location: Jones River+Kingston Bay**

G & L Laboratories

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246 Arlington Street, Quincy, MA 02170 Tel: (617) 328-3663 Fax: (617) 472-0706

≤ 200 CFU/100mL - primary contact ≤ 61 CFU/100mL - FRESH
≤ 88 CFU/100mL - shellfishing ≤ 104 CFU/100mL - MARINE

**TEST RESULTS:**

| Sample # | Fecal Coliform(CFU/100mL) | Enterococci(CFU/100mL) | Total Suspended Solids(mg/L) |
|---|---|---|---|
| 1 Shore | 10,000 | 8,000 | --- |
| 2 Shore | --- | --- | 16 |
| 3 Shore | 15,000 | 16,000 | --- |
| 4 Shore | --- | --- | 18 |
| 5 Delano Paved Swale | 38,000 | 28,000 | --- |
| 6 Delano Paved Swale | --- | --- | 24 |
| 7 River St. @ Town Landing | 13,000 | 5100 | --- |
| 8 Town Landing | --- | --- | 10 |
| 9 Bay Farm | 2500 | 4900 | --- |
| 10 Bay Farm | --- | --- | 10 |
| 11 Marsh Rd | > 80,000 | 16,000 | --- |
| 12 Marsh Rd | --- | --- | 10 |
| 13 Jones R. Dr. @ #19 | 4300 | 14,000 | --- |
| 14 Jones R. Dr. @ #9 | --- | --- | 4 |
| 15 Jones R. Dr. @ #5 | 2500 | 15,000 | --- |
| 16 " | --- | --- | 6 |
| 17 Landing @ JRDA | 6500 | 7500 | --- |
| 18 " | --- | --- | 24 |
| 19 " | 4100 | 6800 | --- |
| 20 " | --- | --- | 14 |
| 21 Landing behind substation | 7600 | 18,000 | --- |
| 22 " | --- | --- | 10 |
| 23 Landing @ playground OHH | 270 | 6100 | --- |
| 24 " | --- | --- | 24 |
| 25 Maple St. @ Stony Brook | 19,000 | 27,000 | --- |
| 26 " | --- | --- | 30 |
| 27 Park St. in channel | 680 | 780 | --- |
| 28 " | --- | --- | 10 |
| 29 " | 640 | 500 | --- |
| 30 " | --- | --- | 6 |
| 31 Riverside | 2900 | 20,000 | --- |
| 32 " | --- | --- | 6 |
| 33 MassDOT #1 | 3600 | 4600 | --- |
| 34 " | --- | --- | 4 |
| 35 MassDOT #2 | 4000 | 26,000 | --- |
| 36 " | --- | --- | 20 |
| **Method Reference** | **SM 9222D** | **EPA 1600** | **SM 2540D** |

**Mass. Cert. No.: M-MA-1100**

G & L Labs., Inc.

Diana Liu
Laboratory Director

G & L Laboratories

✦ Water Analysis ✦ Food/Seafood Analysis ✦ Metals/Chemical Analysis ✦ Microbiological Testing

246 Arlington Street, Quincy, MA 02170 Tel: (617) 328-3663 Fax: (617) 472-0706

# REPORT

November 9, 2011

**Lab. I. D. # 58397**

Attn: Ms. Maureen Thomas
Kingston Recreation Dept.
26 Evergreen St.
Kingston, MA 02364

**Sample Received Date/Time:** 10/27/11, 11:45 AM
**Sample Received Temperature:** N/A
**Sample Identification:** Thirty-six (36) storm water samples labeled:

Shore Dr. 1. #059 (Collected Date/Time: 10/27/11, 7:28 AM)
Shore Dr. 2. #059 (Collected Date/Time: 10/27/11, 7:28 AM)
Delano 3. #DPS1 (Collected Date/Time: 10/27/11, 7:19 AM)
Delano 4. #DPS1 (Collected Date/Time: 10/27/11, 7:20 AM)
River St. @ Town Landing 5. #041A (Collected Date/Time: 10/27/11, 7:41 AM)
" 6. #041A (Collected Date/Time: 10/27/11, 7:42 AM)
" 7. #041A (Collected Date/Time: 10/27/11, 7:43 AM)
" 8. #041A (Collected Date/Time: 10/27/11, 7:44 AM)
Bay Farm 9. #041B (Collected Date/Time: 10/27/11, 7:52 AM)
" 10. #041B (Collected Date/Time: 10/27/11, 7:52 AM)
Marsh Rd 11. #041 (Collected Date/Time: 10/27/11, 8:00 AM)
" 12. #041 (Collected Date/Time: 10/27/11, 8:01 AM)
Jones R. Dr. @ #19 13. #047 (Collected Date/Time: 10/27/11, 8:08 AM)
" 14. #047 (Collected Date/Time: 10/27/11, 8:09 AM)
" 15. #047 (Collected Date/Time: 10/27/11, 8:10 AM)
" 16. #047 (Collected Date/Time: 10/27/11, 8:11 AM)
Jones R. Dr. @ #5 17. #047B (Collected Date/Time: 10/27/11, 8:19 AM)
" 18. #047B (Collected Date/Time: 10/27/11, 8:20 AM)
Landing @ JRiver 19. #195 (Collected Date/Time: 10/27/11, 8:29 AM)
" 20. #195 (Collected Date/Time: 10/27/11, 8:30 AM)
Landing Rd. behind substation 21. #197 (Collected Date/Time: 10/27/11, 8:41 AM)
" 22. #197 (Collected Date/Time: 10/27/11, 8:42 AM)
Landing Rd @ playground 23. #198 (Collected Date/Time: 10/27/11, 8:53 AM)
" 24. #198 (Collected Date/Time: 10/27/11, 8:54 AM)
" 25. #198 (Collected Date/Time: 10/27/11, 8:55 AM)
" 26. #198 (Collected Date/Time: 10/27/11, 8:56 AM)
Maple St @ Stony Brook 27. #043 (Collected Date/Time: 10/27/11, 9:08 AM)
" 28. #043 (Collected Date/Time: 10/27/11, 9:09 AM)
Park St. in channel 29. #193 (Collected Date/Time: 10/27/11, 9:18 AM)
" 30. #193 (Collected Date/Time: 10/27/11, 9:19 AM)
Riverside Dr. 31. #051A (Collected Date/Time: 10/27/11, 9:29 AM)
" 32. #051A (Collected Date/Time: 10/27/11, 9:30 AM)
East of Rte 3 bridge 33. Mass Dot #1 (Collected Date/Time: 10/27/11, 10:19 AM)
" 34. Mass Dot #1 (Collected Date/Time: 10/27/11, 10:21 AM)
L. Knife Outfall 35. Mass Dot #2 (Collected Date/Time: 10/27/11, 10:12 AM)
" 36. Mass Dot #2 (Collected Date/Time: 10/27/11, 10:13 AM)

**Sampling Location: Jones River + Kingston Bay**

G & L Laboratories

✦ Water Analysis ✦ Food/Seafood Analysis ✦ Metals/Chemical Analysis ✦ Microbiological Testing

246 Arlington Street, Quincy, MA 02170 Tel: (617) 328-3663 Fax: (617) 472-0706

**TEST RESULTS:**

| Sample # | Fecal Coliform(CFU/100mL) | Enterococci(CFU/100mL) | Total Suspended Solids(mg/L) |
|---|---|---|---|
| Shore Dr. 1 #059 | 2400 | 21,000 | --- |
| 2 #059 | --- | --- | 24 |
| 3 #DPS1 | 4600 | 57,000 | --- |
| 4 #DPS1 | --- | --- | 8 |
| 5 #041A | 6400 | 43,000 | --- |
| 6 #041A | --- | --- | 10 |
| 7 #041A | 2500 | 41,000 | --- |
| 8 #041A | --- | --- | 6 |
| 9 #041B | 110 | 1700 | --- |
| 10 #041B | --- | --- | 20 |
| 11 #041 | 2400 | 32,000 | --- |
| 12 #041 | --- | --- | 24 |
| 13 #047 | 600 | 19,000 | --- |
| 14 #047 | --- | --- | 8 |
| 15 #047 | 320 | 28,000 | --- |
| 16 #047 | --- | --- | 10 |
| 17 #047B | 47,000 | >80,000 | --- |
| 18 #047B | --- | --- | 12 |
| 19 #195 | 6500 | 12,000 | --- |
| 20 #195 | --- | --- | 22 |
| 21 #197 | 1800 | 16,000 | --- |
| 22 #197 | --- | --- | 4 |
| 23 #198 | <10 | 120 | --- |
| 24 #198 | --- | --- | 4 |
| 25 #198 | <10 | 100 | --- |
| 26 #198 | --- | --- | 6 |
| 27 #043 | 4900 | 15,000 | --- |
| 28 #043 | --- | --- | 36 |
| 29 #193 | 790 | 3000 | --- |
| 30 #193 | --- | --- | 24 |
| 31 #051A | 4300 | 77,000 | --- |
| 32 #051A | --- | --- | 26 |
| 33 Mass DOT #2 | 2100 | 2900 | --- |
| 34 Mass DOT #2 | --- | --- | 30 |
| 35 Mass DOT #2 | 2700 | 13,000 | --- |
| 36 Mass DOT #2 | --- | --- | 44 |
| **Method Reference** | **SM 9222D** | **EPA 1600** | **SM 2540D** |

**Mass. Cert. No.: M-MA-1100**

G & L Labs., Inc.

Diana Liu
Laboratory Director